Space Weather Technical Forecast

Issued on Saturday, 21 May 2022 at 13:03 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 Radio Blackouts Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the past 24 hours, with the peak X-ray flare observed at GOES16 being a C8.4 at 20/2212UTC, with this emanating from AR3019, currently manifesting as a Cai/Beta and one of seven numbered sunspot regions on the disc.

The facing-side roster of sunspot regions remains dominated by the large and complex AR3014 in the centre northwest quadrant, with this group remaining an Ekc/Beta-Gamma-Delta. This group is likely to be mature, with only slow changes observed in the form of minor trailer development and a slight increase in its intermediate penumbral area in the 24 hours. The Mt Wilson delta spot is now not particularly clear, but occupies the centre of the group. Also of note were sunspot region 3011 in the northwest, which developed rapidly, only to stall, spread and fade as the UTC day of Saturday 21 May dawned; while in the northeast, AR3017 saw rapid proliferation of many minor spots, seeing its earlier Cao/Beta class evolve through Cai and perhaps attaining Dai by the period's end. All other groups were relatively stable and unremarkable over the same interval.

A long-duration C-class flare from AR3011 around 20/1200UTC is likely to have produced a CME, a feat that this group may have repeated at 20/2300UTC. There are large imagery gaps at present in STEREO A COR2, however analysis of both is pending. At present then, there are no confirmed CMEs with Earth-directed components, but two candidates.

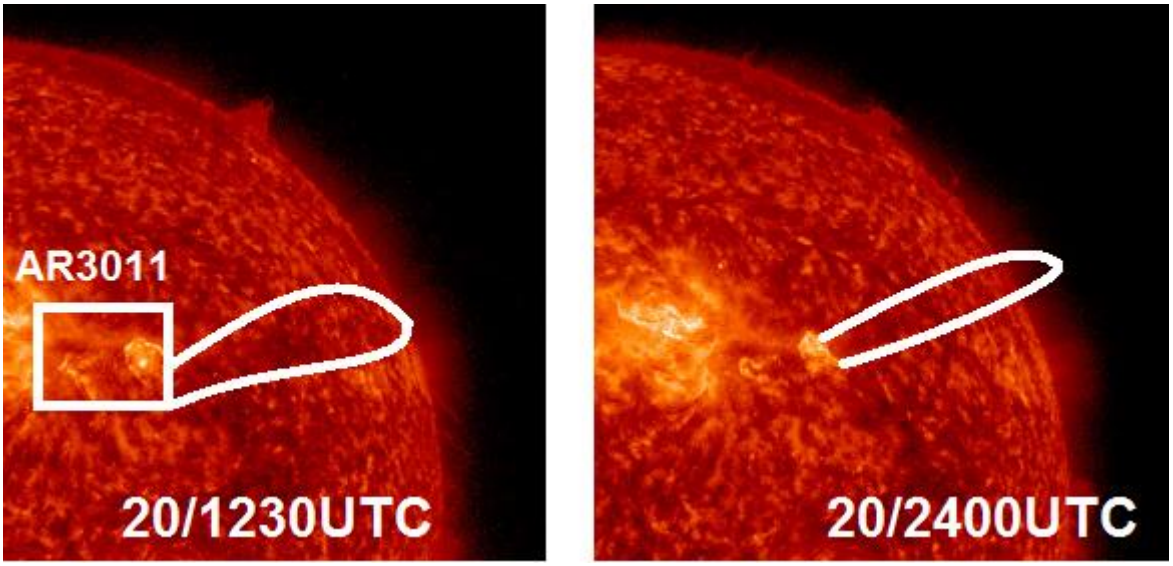

Figure 0: AIA304 imagery of apparent CME-generating events spawned from AR3011 in the period. Analysis of both of these is in course.

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Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was characteristic of a fast wind regime, most likely emanating from CH82/+ in the western solar hemisphere, with the phi angle accordingly positive (away from the sun) throughout the 24 hours. The solar wind speed initially saw a slight rise to peak at a strong 600km/s, before ebbing away slightly into the UTC morning of Saturday to finish nearer 525km/s. The solar wind density showed a slight fall from slightly elevated levels just above 10ppcc, ending the 24 hours in single figures ppcc, while the IMF edged downwards from an early peak of 6nT and a north-south component of +/-6nT.

The net result of the above solar wind measures was provisionally Quiet to Unsettled Kp, with a peak of 3+ in the 21-24UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux (greater than 2 MeV) was at Normal Background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu). Observed fluence at 21/0001UTC was 2.93e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Likely to be Moderate, with a continuing daily Slight Chance of an isolated Strong-class flare (R3 Radio Blackout). The main source of the activity is likely to be from AR3014, although some significant flaring is also possible from AR3019, with a lower chance from the remaining regions.

Solar Wind / Geomagnetic Activity: No CMEs feature in the current forecast, although note that there are up to two candidates undergoing assessment for any Earth-bound component.

Otherwise, the only enhanced geomagnetic activity in the coming four days ought to be from the incumbent fast wind from CH82/+, with this feature likely to have already peaked. Today's Slight Chance of G1 should fall with time, with reliably Quiet geomagnetic conditions expected to be reinstated by the end of the current four days.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period, but with a daily Slight Chance of flux reaching S1, should any notable flares occur.

The high energy electron flux (greater than 2 MeV) is forecast to remain at mainly Normal Background levels at first, but with an increasing chance of the diurnal peak reaching High levels once geomagnetism from CH82/+ fades later this UTC weekend. The 24-hour electron fluence will most Likely remain below the Active (1e8 integrated pfu) threshold during the forecast period, albeit with a rising trend.

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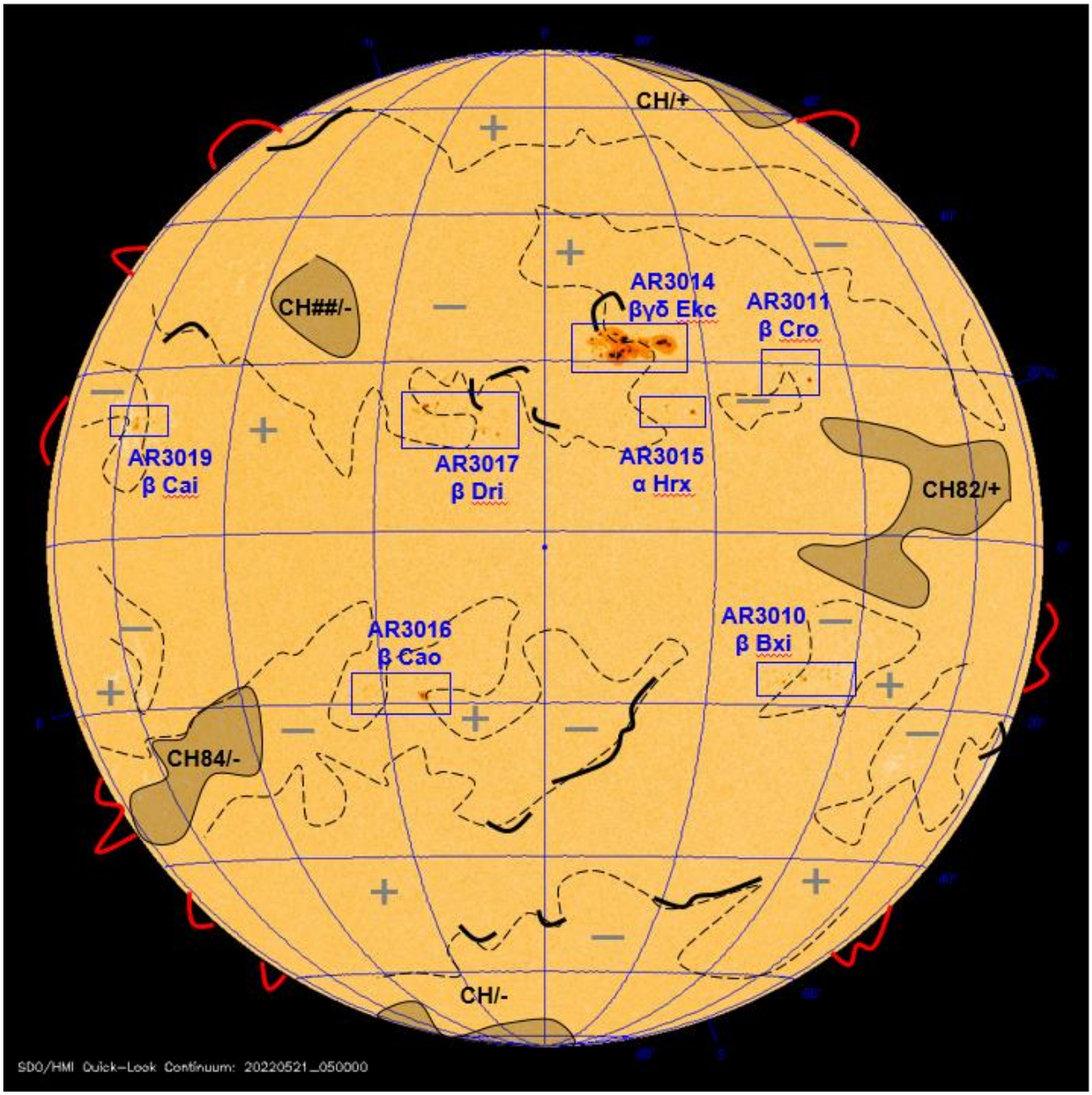
Figure 1. Solar Analysis Valid 21/0500UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Coronal Mass Ejections (CMEs) feature in the current forecast, although it should be noted that there are some minor candidates emitted from near AR3011 in the past 24 hours that are pending imagery for analysis.

The current fast solar wind emanating from CH82/+ is the only such feature in the four-day period, and this has now peaked. The chances of Minor Storm G1 are therefore Slight and ought to peak early in the forecast before the resumption of a slow regime by the end of the period and predominantly Quiet conditions.

MOSWOC SWPM suggests that a fast wind may feature at the very end of the current forecast period, however the relevant persistent feature on the disc, CH84/+, appears around a day further east on this rotation and the high speed stream is unlikely to become geoeffective until midweek at the earliest. There is also a new, tenuous coronal hole in the northeastern quadrant that may shortly precede any influence from CH84/-, however this still is perhaps most likely from midweek UTC - and in any case, appears to be of the same polarity and is unlikely to be distinguishable from its recurrent neighbour.

Adding weight to the above, STEREO A MAG and PLASTIC data is currently very patchy, but also shows now obvious enhancement inside the next 2.5 days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil, but note up to two unassessed candidates.

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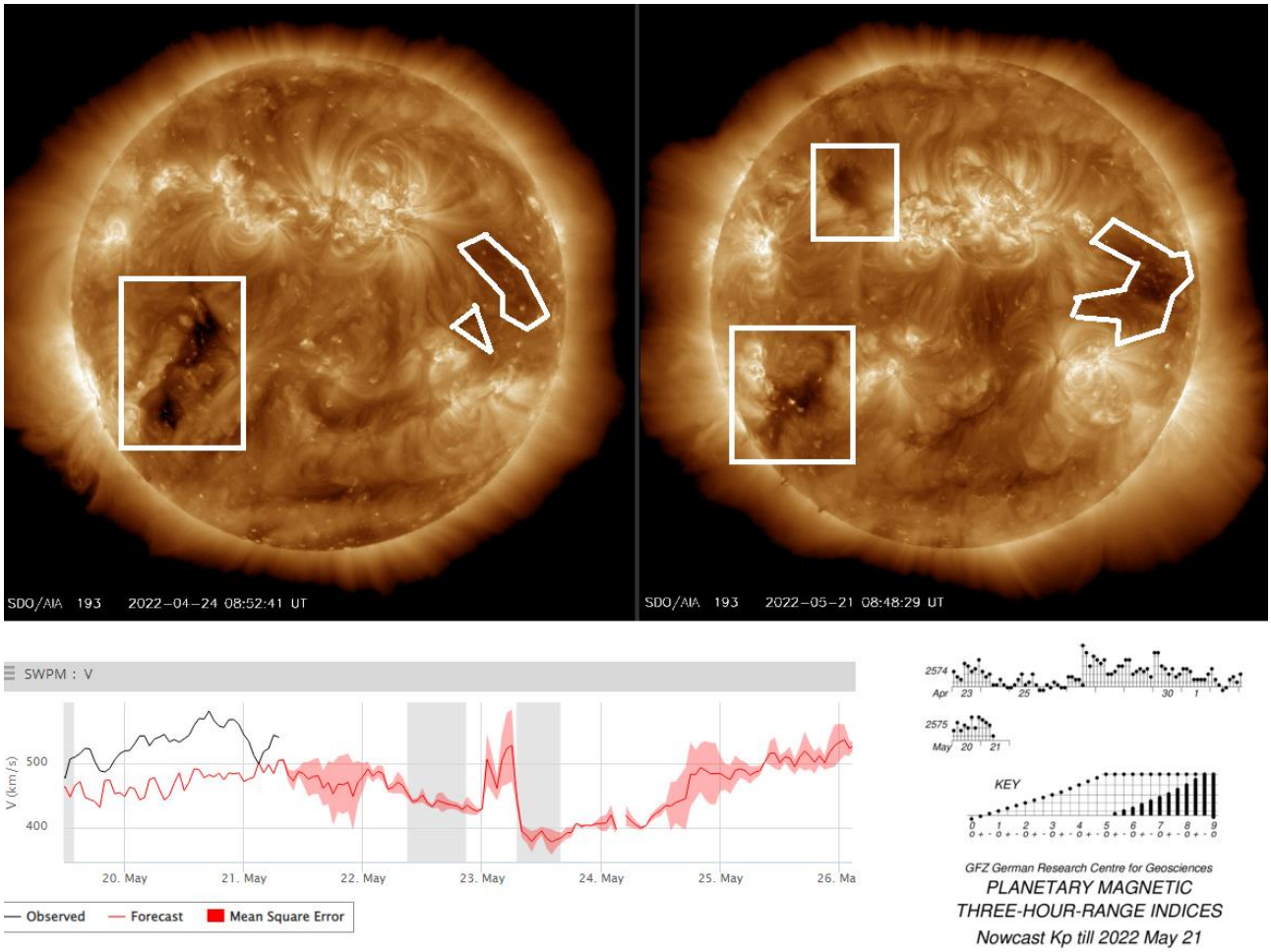
Figure 2: Clockwise from top left: 24 April AIA193 image showing coronal hole geometry on last rotation; compare with today's image top right; Bartels music plot for geomagnetism during the forecast period and on last rotation; MOSWOC SWPM suggestions – note the featur earound 23 May is a CME, while the enhancement from CH84's predecessor late on 24 May is likely to be delayed.



Radio Blackouts - X-Ray Flares:

There are currently seven numbered sunspot regions on the solar disc. By far the largest and nominally most complex remains AR3014, however this group's activity has lessened somewhat in recent days, with the cadence of M-class flares falling, even if their magnitude is similar (low M-class). Reasons for this are likely to be related to the spot's maturity and slow changes in growth.

While much smaller in stature, rapid proliferation of minor intermediate pores and spots over the past 24 hours in AR3016 is perhaps something to monitor, with its Cao/Beta classification of this morning's solar synoptic map now already at least a Cai and perhaps a Dai in Zurich class. Other spot groups were less noteworthy in the period, as although AR3011 underwent a growth phase early in the 24 hours, this stalled and a spreading and fading tendency took over into the UTC day of Saturday 21 May.

Regarding the balance of sunspot groups, no significant regions leave the Earth-facing side in the four days, while STEREO A EUVI195 imagery does suggest some returning candidate regions over the eastern limb. A slight upward trend in risk is therefore possible, however any contribution from these new regions will be assessed as and when they present for analysis.

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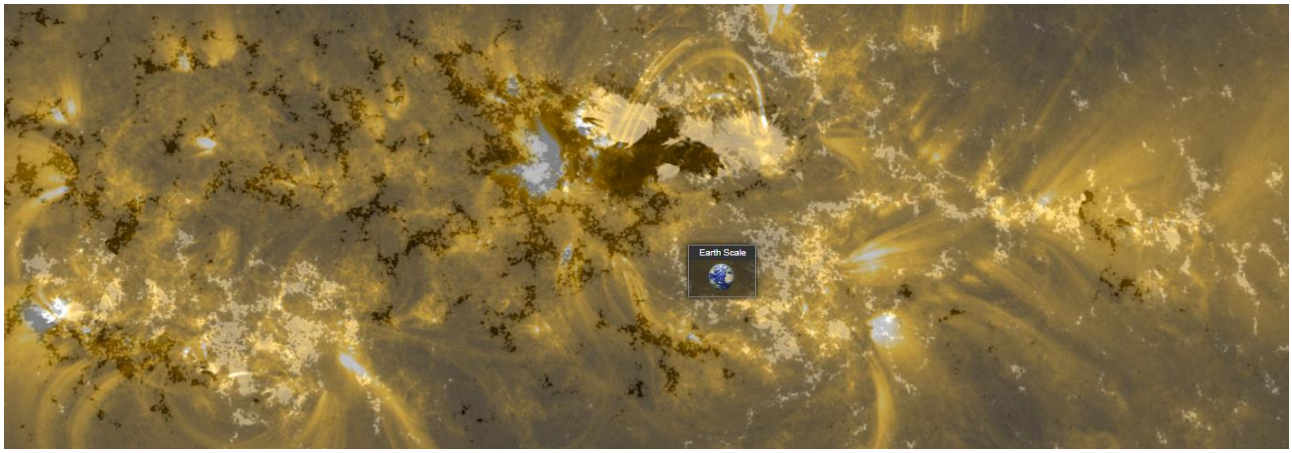
X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: 21/1050UTC Helioviewer.org-generated composite image showing HMIB and AIA171 overlaid for (left to right) sunspots AR3017, 3014 and 3011.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain at that level through the period.

The daily risk of surpassing S1 should very slightly increase over the four-day period, although the raw probability is close to 10% throughout and that figure is therefore used throughout. This risk is the result of the westward progress of the largest and nominally most complex region on the disc, although despite some M-class activity, this has not yet proven to have delivered any proton enhancement at Earth.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO is currently mostly within Normal Background levels.

On the previous rotation, the current fast solar wind regime proved incapable of resulting in Active 24-hour integrated electron fluence. The current solar wind enhancement from CH82/+ is slightly enhanced in comparison, so while flux may increasingly trouble the High boundary, on balance it should most likely average out below Active 24-hour fluence, even as CH82/+ and its resultant geomagnetic activity wane into the forthcoming working week.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	20	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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